

# POLYMERS AND OLIGOMERS, THEIR SYNTHESIS, AND ELECTRONIC DEVICES INCORPORATING SAME

**[0001]** This application claims the priority of U.S. Provisional Application Serial No. 60/275,762, filed March 14, 2001 and U.S. Provisional Application Serial No. 60/275,443, filed March 13, 2001.

## TECHNICAL FIELD

**[0002]** The invention relates to polymers and oligomers, methods of their synthesis, and electronic devices comprising them.

## BACKGROUND OF THE INVENTION

**[0003]** The present invention is directed to polymeric compositions useful in producing electronic devices. It is an object of the present invention to produce stable compositions capable of functioning in a wide variety of electronic devices.

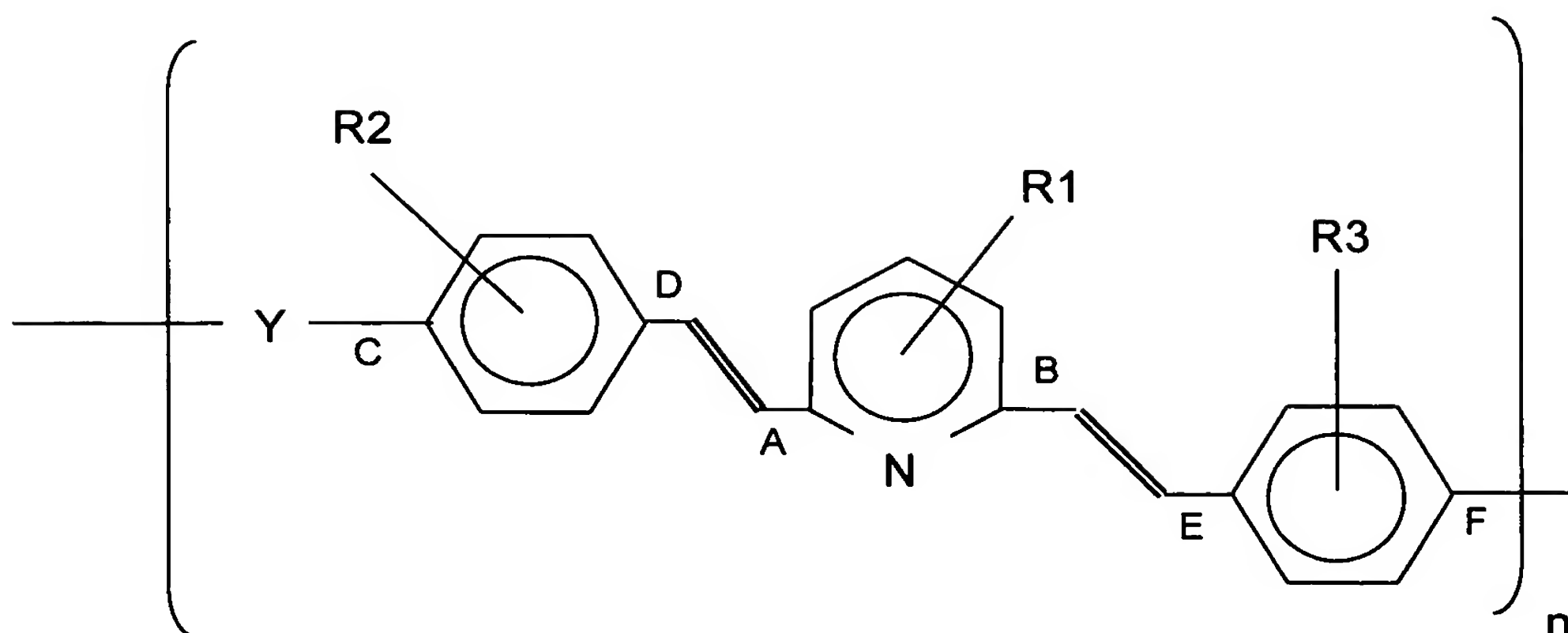
**[0004]** Novel features and advantages of the present invention, in addition to those mentioned above, will become apparent to those skilled in the art from a reading of the following description or from practice of the invention.

## SUMMARY OF THE INVENTION

**[0005]** The present invention includes compositions of matter including polymers, oligomer and their constituent monomeric units. The present invention also includes methods of making the compositions and devices made therefrom.

### Polymer 1

**[0006]** The present invention includes a composition of matter comprising a polymer of the general structure:



wherein the R1 substituents are independently selected from the group consisting of hydrogen, alkyl groups, alkoxy groups, and aryl groups;

the R2 substituents are independently selected from the group consisting of hydrogen, alkyl groups, alkoxy groups, and aryl groups;

the R3 substituents are independently selected from the group consisting of hydrogen, alkyl groups, alkoxy groups, and aryl groups;

wherein bonds A and B may independently be either ortho, meta or para with respect to the pyridyl nitrogen;

wherein bonds C and D may be either ortho, meta or para with respect one another;

and wherein bonds E and F may be either ortho, meta or para with respect one

another; wherein Y may be a moiety selected from the group consisting of  $-(CH_2)_x-$ ,  $-(CH_2)_xO-$ ,  $-O(CH_2)_x-$  and  $-O(CH_2)_xO-$  wherein x is an integer in the range of 1 to 15

inclusive; and

wherein n is an integer greater than 1.

**[0007]** The R2 substituent is preferably a methoxy group with most preferably at least two R2 substituents being methoxy groups. The R3 substituent is preferably a methoxy group with most preferably at least two R3 substituents being methoxy groups.

**[0008]** It is preferred that the vinyl linkages A and B attach at positions ortho to the pyridyl nitrogen. It is also preferred that bonds C and D be para with respect one another, and that E and F be para with respect one another.

**[0009]** It is also preferred that x be an integer in the range of 1 to 6 inclusive.

**[0010]** These block co-polymers may have geometries and substituents, as do the oligomers from which they are derived, as described above.

**[0011]** The compositions of the present invention may be used to fabricate a wide variety of electronic devices, such as those that may be made in accordance with known production procedures. These devices include polymeric light emitting devices, including mono- and multi-color devices, color-variable devices, infrared-emitting devices; so-called SCALE devices, including two-color and multi-color SCALE devices. Other devices in which compositions of the present invention may be used include photovoltaic devices and polymer-based transistors. Examples of these devices that are disclosed in U.S. patents Nos. 6,004,681; 5,955,834; 5,858,561; 5,663,573 and several co-pending patent applications serial numbers 09/041,337; 08/902,145; 08/901,888 and 60/187,278, all of which patents and patent applications are hereby incorporated herein by reference.

**[0012]** The compositions of the present invention may be ambipolar such that they may be used in layered polymeric devices, and may form part of as electron- or

hole-transmissive materials and/or light emitting layers, in accordance with known arrangements. The compositions may also be used as components of blends in the devices described above.

#### DETAIL DESCRIPTION OF PREFERRED EMBODIMENT(S)

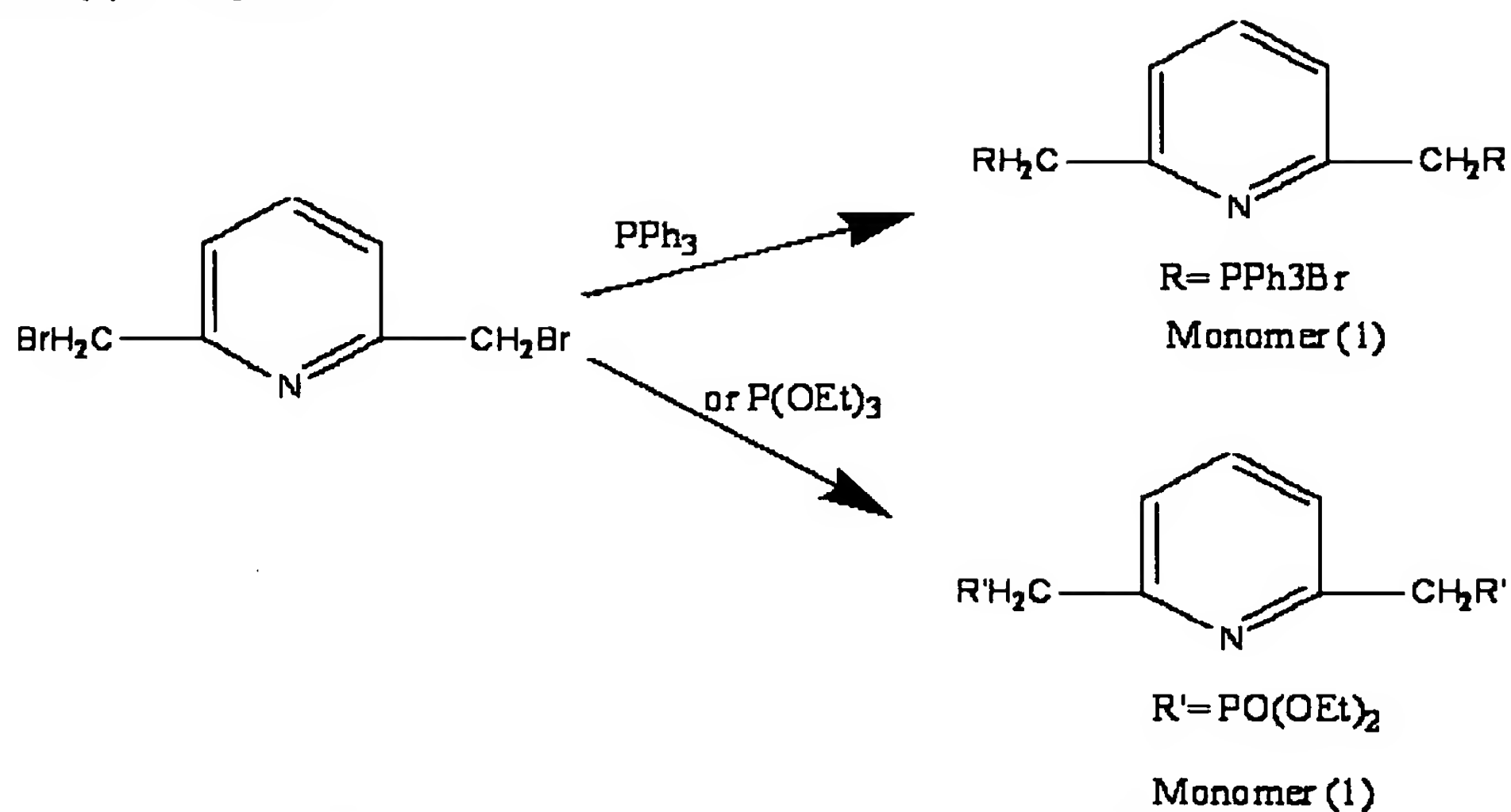
**[0013]** In accordance with the foregoing summary of the invention, the following represent illustrative examples of the invention, and include the best mode. The preferred embodiments herein described are not intended to be exhaustive or to limit the invention to the precise variations disclosed. They are chosen and described to explain the compositions and methods of the invention, and the application of the compositions, so that others skilled in the art may practice the invention.

**[0014]** The following describe a procedure for making the monomers from which the Polymers 1 (described in Example 1) may be produced.

#### Monomer Synthesis

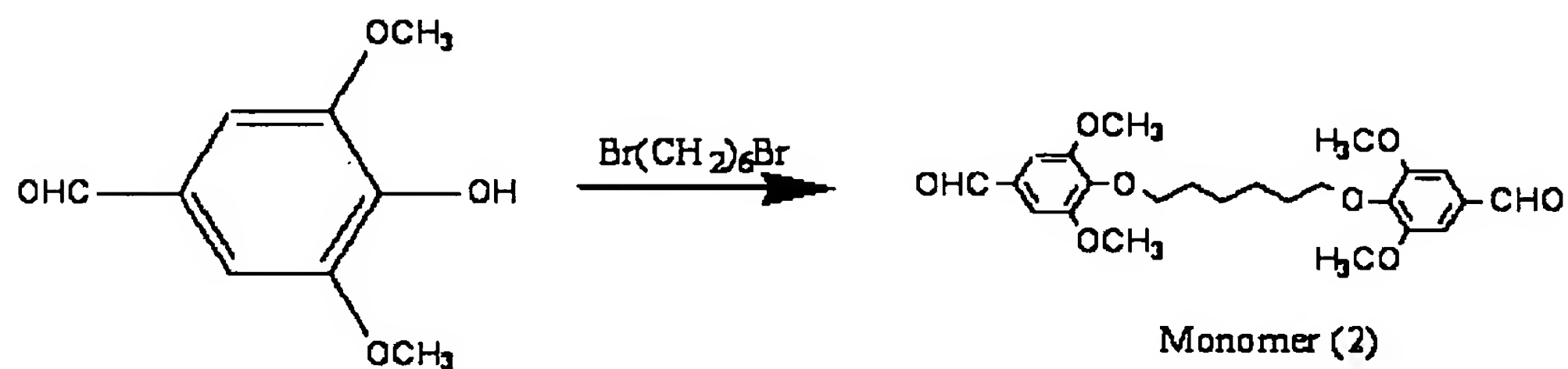
Following are the monomer synthetic scheme of Polymer 1 and Polymer 2:

Monomer (1) in **Polymer1**:

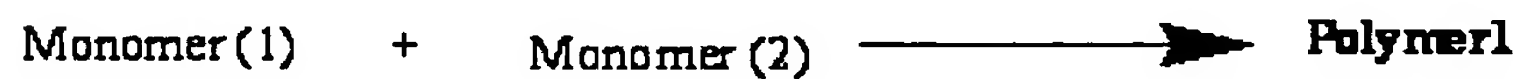


(Similar synthetic method can be found from the Macromolecule, 26, 1188-1190, 1993)

Monomer (2) in **Polymer1**:

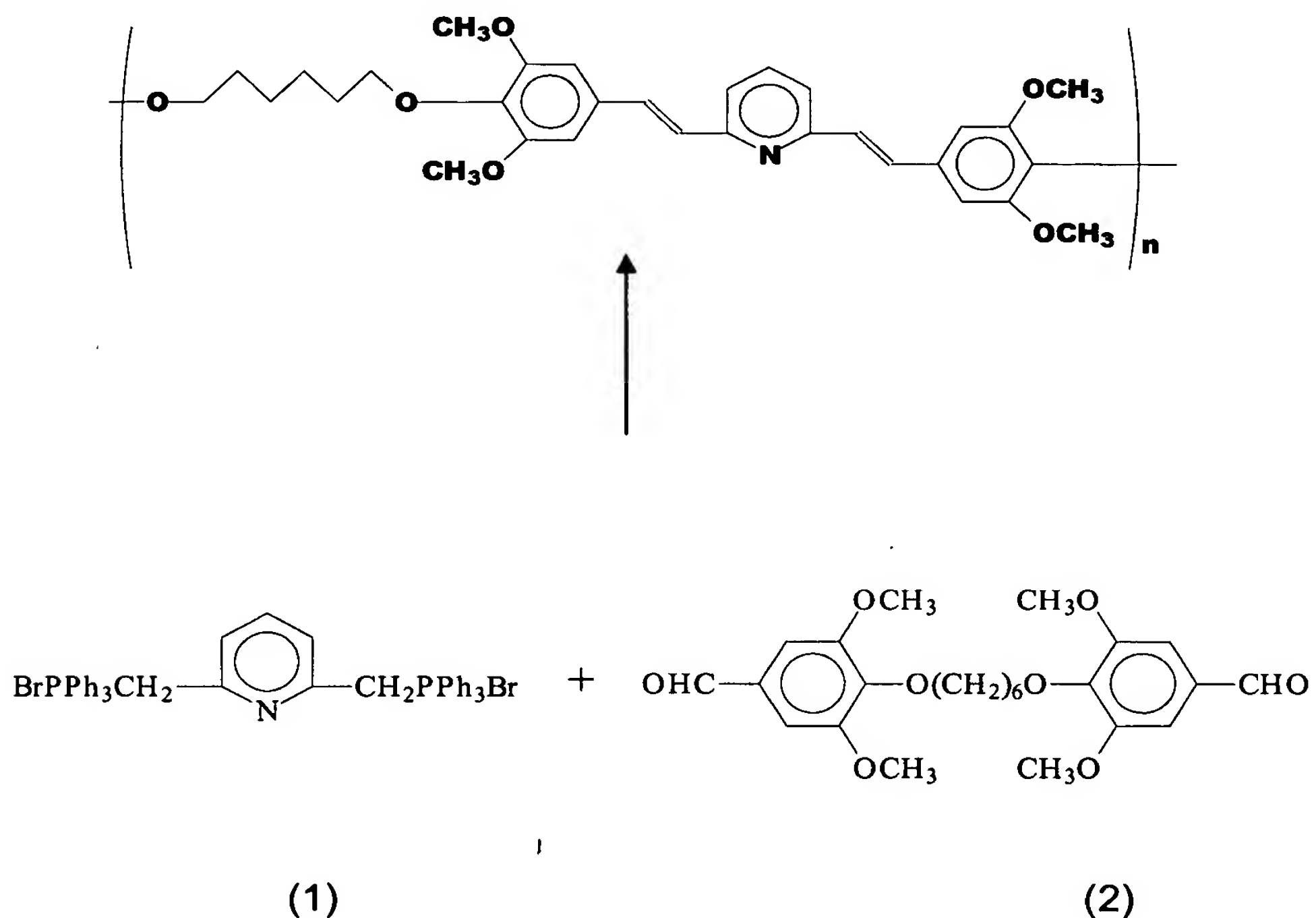


(Similar synthetic method can be found from the Macromolecule, 26, 1188-1190, 1993)



### Example 1 - Polymer 1: 150mg

**[0015]** This Example shows the synthetic scheme through which a polymer in accordance with one embodiment of the present invention may be produced.



**[0016]** To a stirred solution of 502mg (1.12mmol) of the dialdehyde (2) and 890mg (1.12mmol) of the 1,4-pyridyllylenebis(triphenylphosphonium) (1) in 150ml THF was added dropwise a solution of 10ml KotBu (2M in THF) (excess). The

mixture was refluxed for 2 h after the addition. Remove the THF and the solid product was dissolved in  $\text{CHCl}_3$ , and then precipitate from MeOH. The resulting precipitate was collected by suction filtration. Further purification by Soxhlet extraction with methanol for 12 hours afforded Polymer 1 as a light-yellow solid. The solid product was dried in a vacuum oven at 50 °C for 2 days (92% yield). The following NMR data was obtained:  $^1\text{H}$ -NMR( $\text{CDCl}_3$ ): 1.4 (m, 4 H), 1.6 (t, 4 H), 3.7 (s, 12 H), 3.9 (t, 4 H), 6.7 (s, 4 H), 7.0 (t, 1 H), 7.1 (d, 4 H), 7.5 (d, 2 H).

**[0017]** Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention. Thus, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.